JPEG 2000

- **ISO/IEC 15444 Part 1**
  - **Wavelet based decomposition by resolution**
  - **Arithmetic entropy encoding**
  - **Pixel precision from 1 to 37 bits per pixel**
  - **Single and multiple bands**
  - **Both numerically lossless and lossy options**
  - **Very scalable**
  - **Many processing options can be done in the compressed data domain (w/o decompression)**
  - **Suitable for today's PC's, Hand-helds, scanners, digital cameras, etc.**

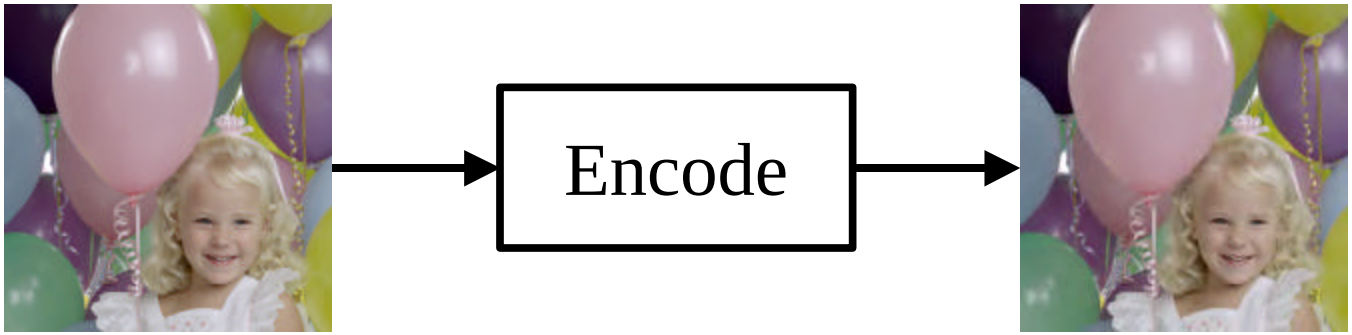
JPEG2000 Standard Status

- The standard only specifies a decoder and a bitstream syntax and is issued in several parts:
  - **Part I:** specifies the minimum compliant decoder (e.g., a decoder that is expected to satisfy 80% of applications); International Standard (IS) has been approved 12/30/00. This has currently been published by the ISO.
  - **Part II:** Describes optional features and value added extensions. International Standard (IS) was approved 1/10/01.
  - **Part III:** Motion JPEG 2000 with file format from MPEG 4. International Standard was approved.
  - **Part V:** Reference software: Two versions of reference software (JAVA, C++). International Standard was approved. The US has brought concerns that the reference software is currently not fully compliant to the Part 1 standard.

J2K Standard Status (cont.)

- **Part IV:** Compliance testing procedures. The FDIS was balloted in March 2002. Compliance test image and procedures are very important for the promotion of “compliant” standards and interoperability. Imagery is available on the internet.
- **Part VI:** Compound document. Being developed to support compound documents (text, graphics, and images) using the Mixed Raster Content (MRC) defined in ISO 16458. Currently at FCD.

Old Compression Paradigm (JPEG Baseline)



Encoder choices

color space
quantization
entropy coder
pre-processing

No decoder choices

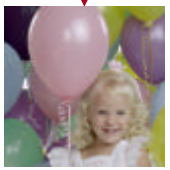
only one image
post-processing

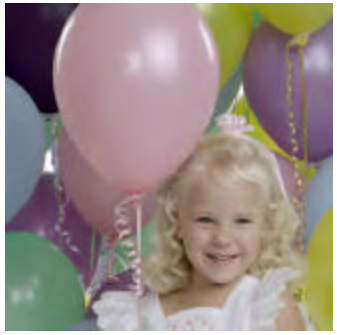
NEW COMPRESSION PARADIGM

Encode choices

Old paradigm choices +
Contone or binary
Tiling
Lossy/lossless

Encode





Decode choices

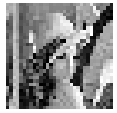
Image resolution
SNR fidelity
Visual fidelity
Target filesize
Lossless/lossy
Region-of-interest

SNR SCALABILITY EXAMPLE

All images have been decompressed from the same bit-stream

RESOLUTION PROGRESSIVE EXAMPLE

All images have been decompressed from the same bit stream. The wavelet decomposition provides a natural resolution hierarchy.



REGION OF INTEREST (ROI) EXAMPLE

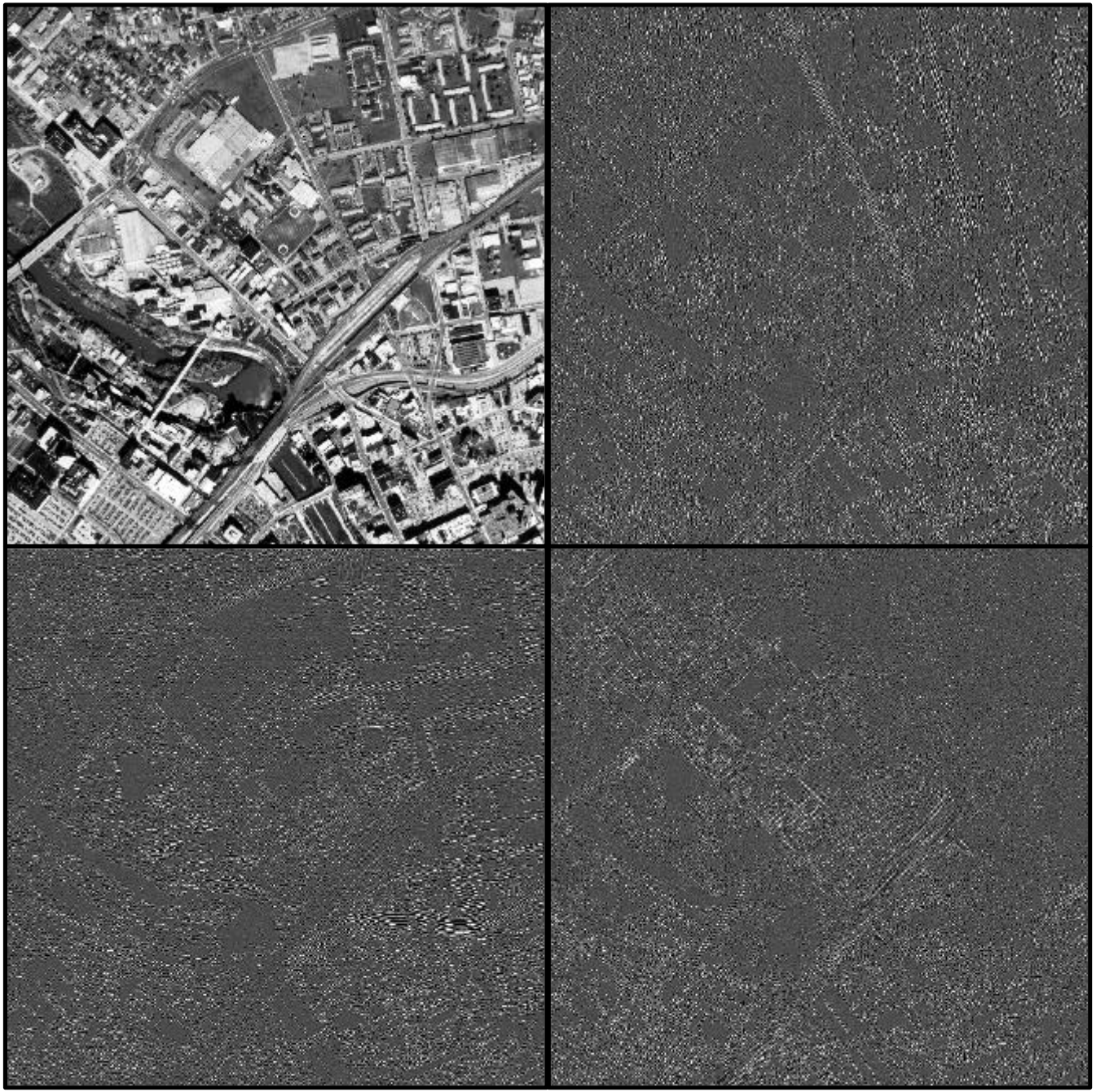
ROI has bit rate of 2.0 bpp

Rest of image has bit rate of 0.0625 bpp

Bit rate for entire image is 0.12 bpp

Original
1024-by-1024

Low-Low

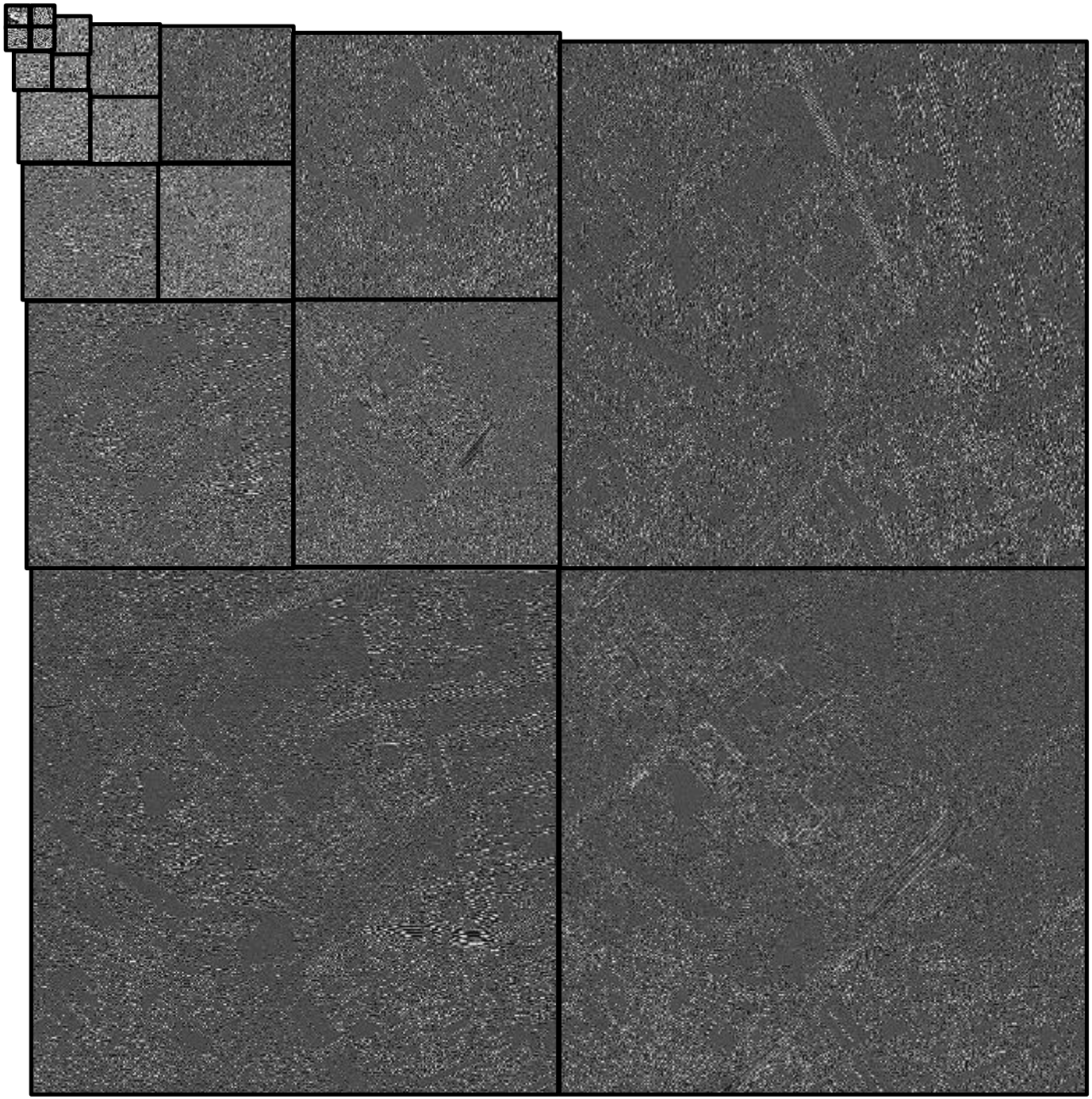


High-Low

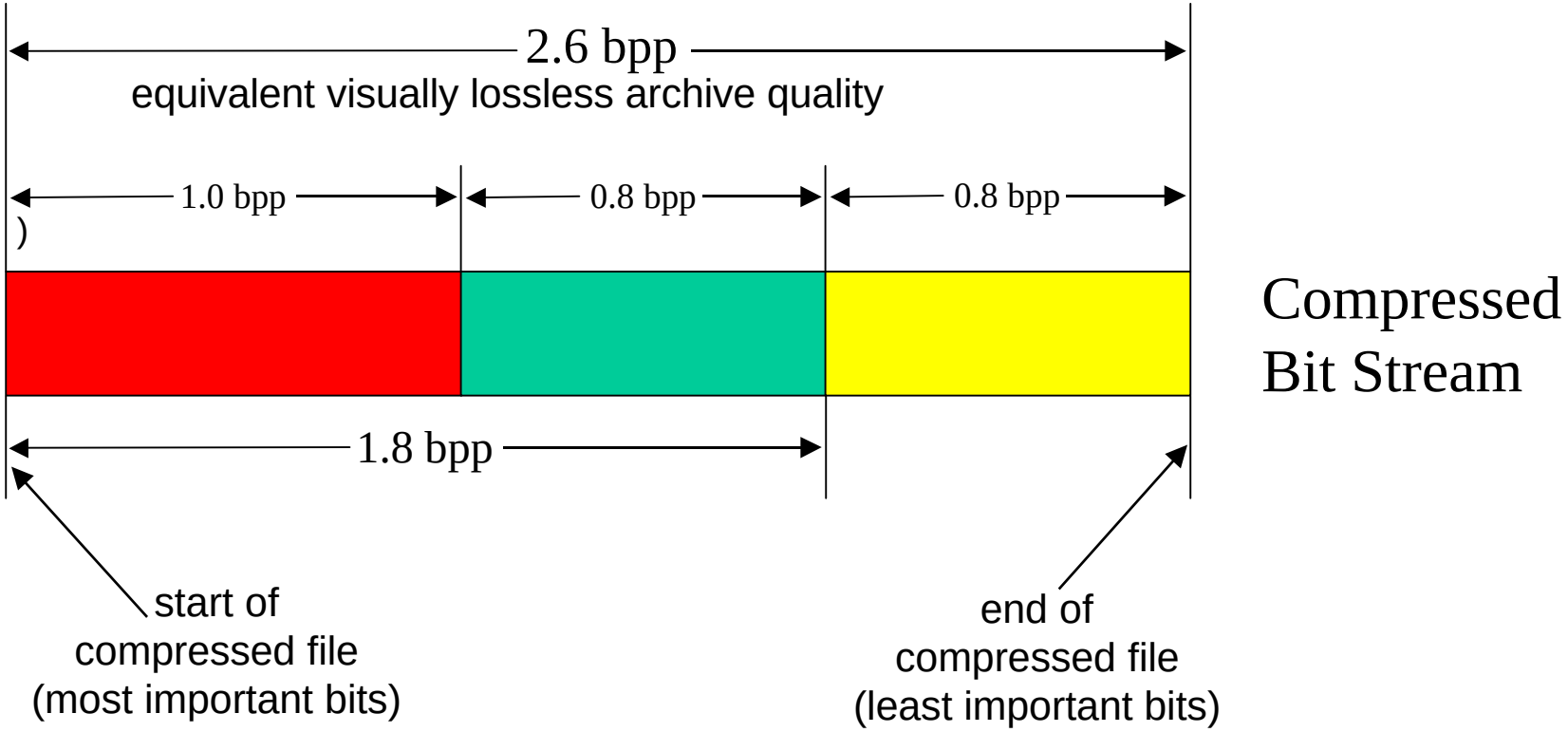
Low-High

High-High

Wavelet Pyramid decomposition



Embedded Bit Stream Example



Compress to a very high quality (rate). Then, any quality (rate) less than that can be obtained by truncating compressed bit stream.

COMPRESSION - FUTURE

MULTI-SPECTRAL - Correlated

HYPER-SPECTRAL

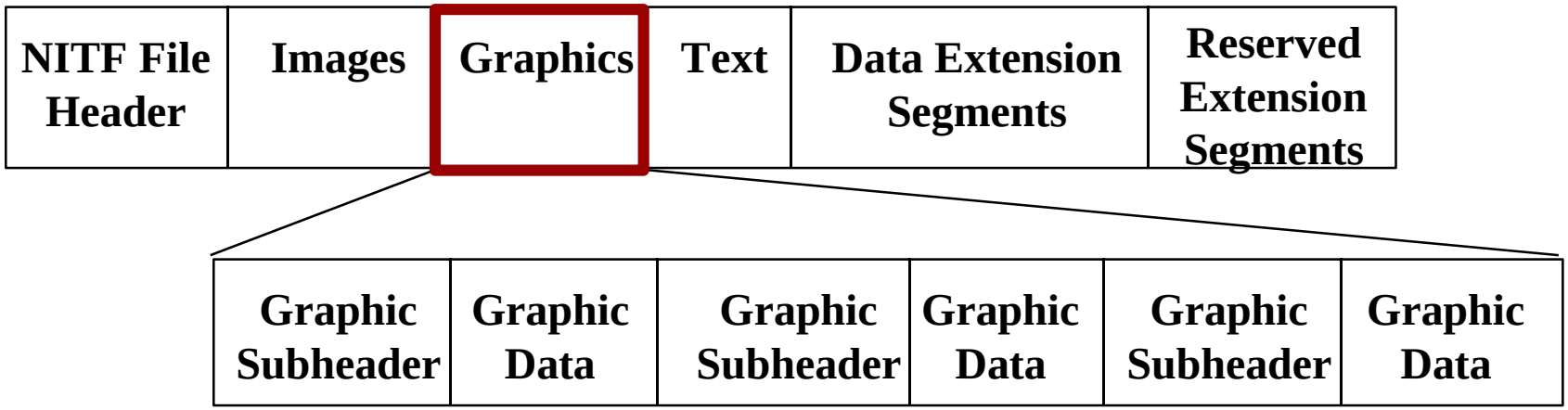
ELEVATION DATA

COMPLEX DATA

ANNOTATIONS

- Graphics/Symbols
  - CGM
  - Bit-Mapped (Legacy)
- Labels (Legacy)
- Text
- Audio (Future)
- Motion Imagery (Future)

NITF GRAPHIC SEGMENT FILE STRUCTURE



SAMPLE NITF GRAPHIC FILE